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INFORMATION

CONCERNING

Methods of Installing the

"Chloride Accumulator"

IN

SMALL RESIDENTIAL LIGHTING PLANTS

ISSUED BY

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA, PA.

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STORAGE BATTERIES

— IN —

SMALL RESIDENTIAL LIGHTING PLANTS

The objects of a battery installation in a residential Lighting Plant may be any or all of the following :

I. 24 hours service with but a few hours daily operation of engine.

II. Reduction in size of engine and generator required.

III. Improved voltage regulation.

IV. A source of current during breakdown of machinery, or while repairs are being made.

I. As the capacity of a battery in this class of service is not generally exhausted in daily operation, it may usually be charged by running the engine and generator two or three hours each day at the most convenient time. In summer, when the lighting hours are shorter, it may even be sufficient to charge once in two or three days.

II. If the plant is so designed that the combined capacity of the generator and the battery is equal to the maximum load requirements, a smaller engine and generator may be installed than would be required if the generator had to carry the total maximum load. The battery will then be discharged in parallel with the generator, to assist it and take a part of the total load on special occasions, when the maximum number of lights is in use.

III. Objectionable fluctuations of voltage and consequent flickering of lights, due for example to the operation of an electric elevator, may be eliminated by floating the battery across the lighting bus.

IV. In case of temporary derangement of the engine or generator, which may occur when the lighting service is most important, or in case repairs to the machinery are required, a battery will serve to tide over the break and avoid any interruption in the current supply.

Number and Capacity of Cells

For 110-volt lamps, 62 cells will usually be found satisfactory, if the battery is not too far from the center of distribution of the lights. This number of cells will permit the voltage to fall one or two volts below 110 at the end of a complete discharge at normal rate, or a little lower at higher rates of discharge, but on the few occasions when a complete discharge is required, this final drop of pressure will not ordinarily be objectionable. If no drop in voltage is permissible, 64 cells would be necessary for 110 volts; or, if the requirements are still less exacting, 60 cells might prove satisfactory.

The capacity of the cells will depend upon the service required and the method of operating the plant. When the customer merely wishes to be able to turn on one or two lights for a few minutes at a time when the engine is not running, the smallest capacity of cell may be sufficient. By estimating the number of lamps which may be required and the aggregate length of time which they must be supplied from the battery without recharging, a battery of suitable capacity may be selected from the tables given herein.

Capacity and Discharge Rates

It will be noted that at rates of discharge greater than the normal or 8-hour rate, the capacity of a battery in ampere hours is somewhat less than the normal capacity, this reduction being practically the same, whether the entire discharge has been effected at the higher rate or the rate is increased after a partial discharge at lower rate. Thus, if a battery has a capacity of 5 amperes for 8 hours, or 40 ampere hours, it can discharge at the rate of 10 amperes for only 3 hours, or 30 ampere hours; and if after full charge it be discharged at the rate of 5 amperes for 4 hours or 20 ampere hours, and the rate of discharge be then increased to 10 amperes, it will give this output for one hour longer, thus giving a total of only 30 ampere hours; whereas, if the rate had not been increased, the discharge could have been continued at 5 amperes for 4 hours longer, giving the full normal capacity of 40 ampere hours.

The final voltage at the end of discharge at the 8-hour rate is about 1.75 volts per cell. At the 3-hour discharge rate, the voltage will fall to about 1.7 per cell.

Example

Assume that the customer wishes to run his generator from dark until 10 P. M., during which time it will carry the lighting load and charge the battery. At 10 P. M. the engine is shut down and the lights are supplied from the battery until dark the following day, the battery output being as follows :

From 10 to 11 P. M.	10	16 c. p. (½ amp.)	lights =	5 ampere hours
" 11 to 12 "	6	16 c. p. (½ amp.)	lights =	3 ampere hours
" 12 to 6 A. M.	2	8 c. p. (¼ amp.)	lights =	3 ampere hours
" 6 to 8 " "	8	16 c. p.	lights =	8 ampere hours
" 8 to dark		No lights required		—
			Total,	19 ampere hours

The final rate of discharge is 4 amperes. A battery should, therefore, be selected which will give 19 ampere hours at a 4-ampere discharge rate, *i. e.*, 4 amperes for 5 hours. From the tables it will be seen that type PT will have this capacity ; but if there is any possibility of these requirements being exceeded at any time, or if the temperature of the battery room is liable to be low, thus temporarily reducing the battery capacity, it will be preferable to allow some margin of capacity, and select type ET.

Assume now that on special occasions a maximum of sixty lights may be required from 8 to 12 P. M. If the generator were to carry this total load, its capacity must be 30 amperes. The battery might, however, be called upon to assist the generator on such occasions, carrying say 10 amperes of the total load and reducing the generator capacity to 20 amperes, which would be sufficient for all ordinary occasions and for charging the battery. From the tables it will be seen that a battery of type D 7 would give the necessary output, namely, 10 amperes for four hours, with some margin of capacity.

Charging Rates

The normal charging rate of a battery is the 8-hour rate, as given in the tables herewith, and if the battery has been completely discharged (at the 8-hour rate) it will require approximately 9 hours to recharge at this rate. As above noted, the capacity of a battery at higher rates is somewhat less in ampere hours than at the normal rate, but at the end of a high rate discharge a battery is not completely discharged, and it is necessary to restore only what has been taken out in ampere hours, plus a small surplus to cover losses.

If the proposed method of operation necessitates charging in a shorter period of time, the 5-hour rate may be used. Ordinarily, only a portion of the total battery capacity will be taken out in daily service, so that except on special occasions, two or three hours per day will be sufficient for charging. The final voltage at the end of charge at normal rate is about 2.5 per cell.

Types of Plants

It will be noted that the voltage of a battery on discharge falls off gradually from about two volts per cell at the beginning to about 1.75 or 1.7 at the end; while during charge the voltage rises from about 2.15 per cell at the beginning to about 2.5 at the end. Several different methods may be adopted for controlling the discharge voltage and maintaining a uniform pressure at the lights, viz.: (1) by connecting in additional or "end" cells one at a time, as the voltage drops, by means of an end cell switch; (2) by a rheostat, whose resistance is cut out step by step; (3) by counter electro-motive force cells, which, like a rheostat, cut down the battery voltage at the beginning of discharge, and are cut out of circuit one by one, by means of an end cell switch.

Also, several methods may be employed for obtaining the necessary increase of voltage for charging, viz.: (1) by dividing the battery into two equal parts and charging these in parallel through a suitable resistance, the generator run-

ning at normal (lamp) voltage; (2) by raising the voltage of the generator sufficiently to charge all the cells in one series; (3) by means of a booster, whose voltage is added to that of the generator, and is varied to give the total required.

The two types of installation herein described and illustrated are those usually recommended for small residence lighting plants, on account of simplicity.

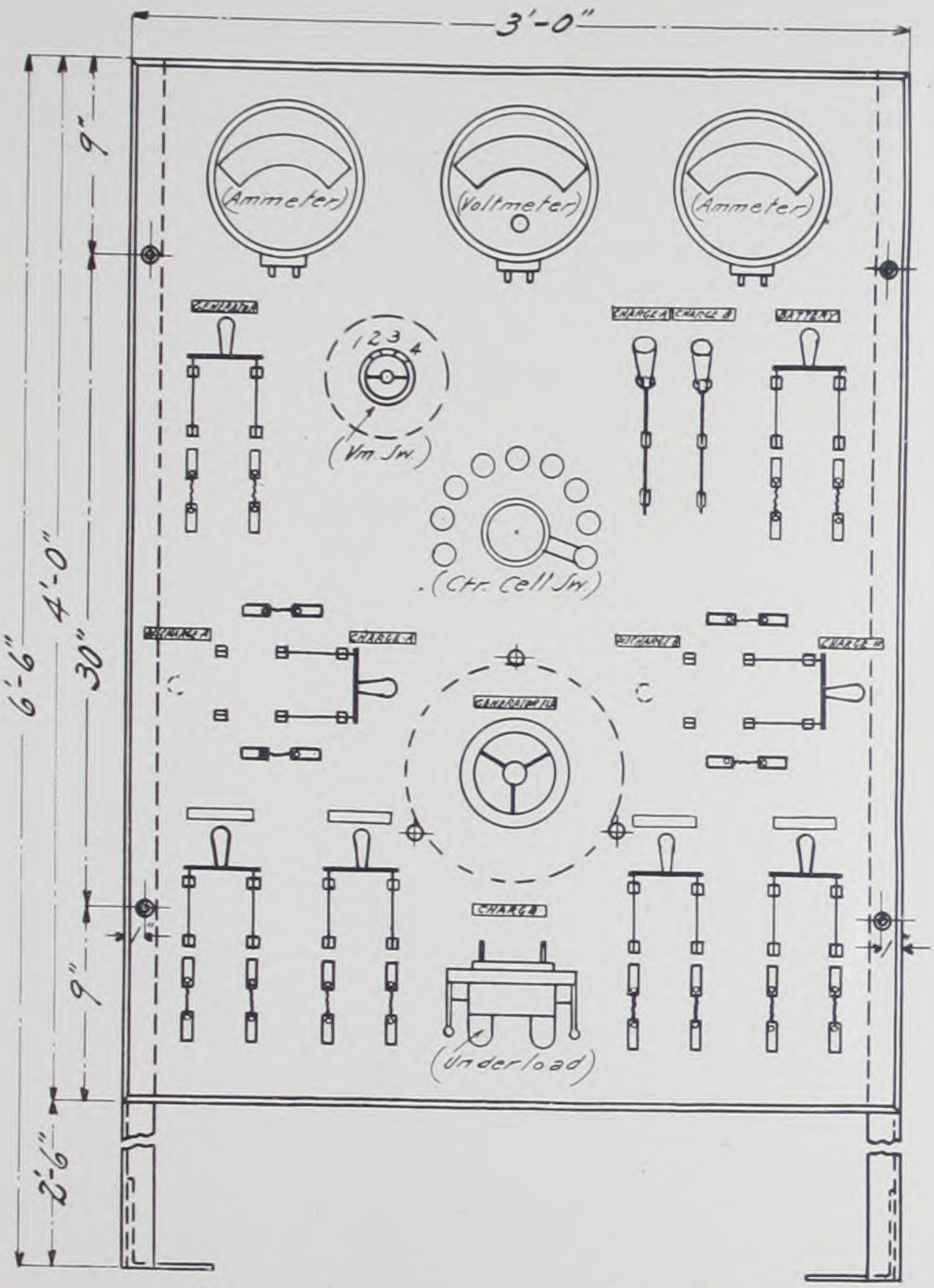

FIG. 1. SWITCHBOARD FOR TYPE A

Type A

In this type of plant the battery is divided into two series, which are charged in parallel through suitable resistances from the 110-volt bus, and are connected in series again for discharge. The voltage on discharge is controlled by counter electro-motive force cells, which may be cut into or out of circuit by an end cell switch on the switchboard.

In fixing the generator capacity, it must be borne in mind that while charging with this type of plant double the charging rate of the battery must be supplied by the generator, in addition to any current for lighting which may be required at that time. Usually, however, the battery will be charged during hours when ample surplus generator capacity is available. Either a shunt-wound or a compound-wound machine may be used.

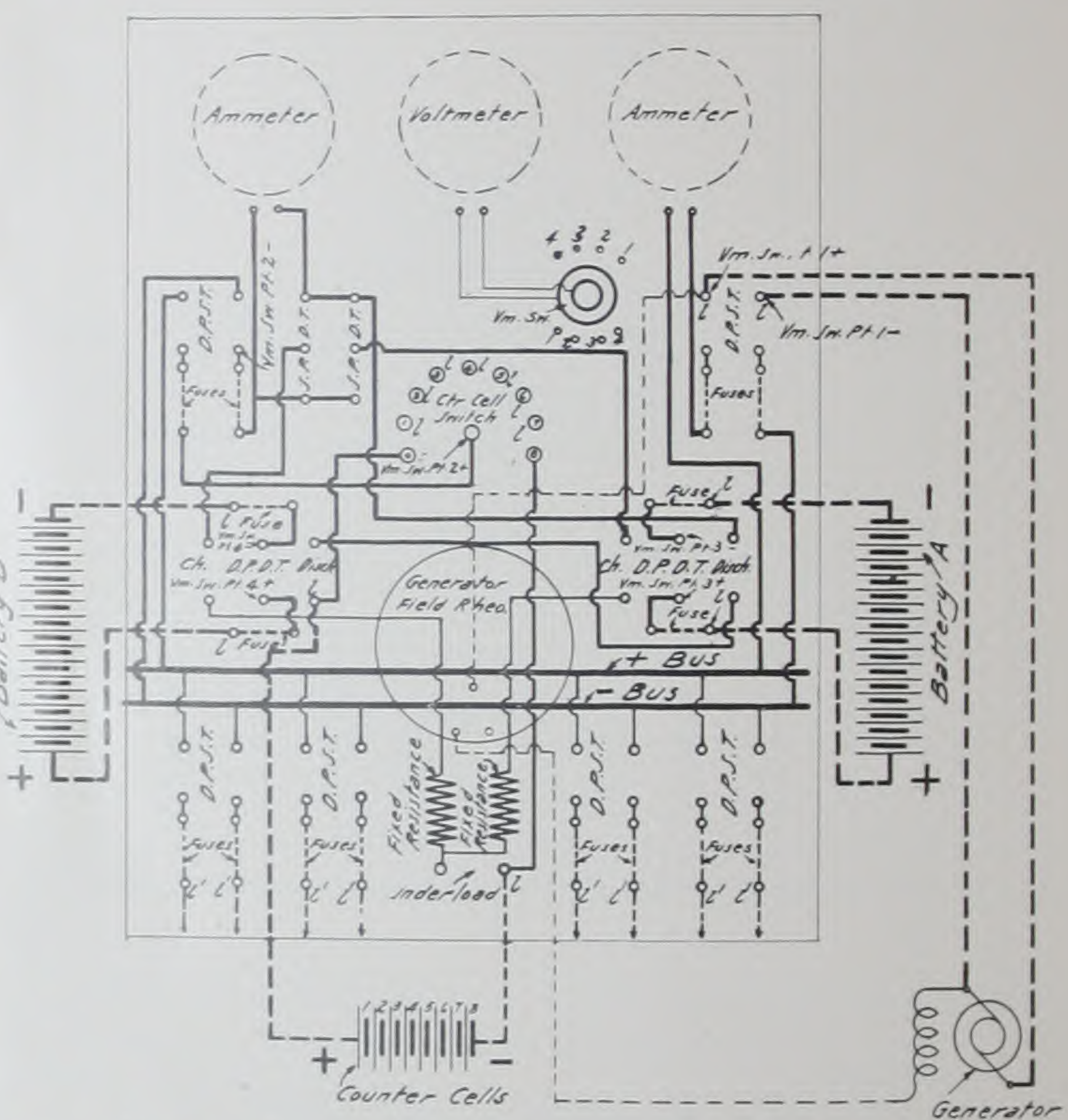

FIG. 2. DIAGRAM OF CONNECTIONS FOR TYPE A

Figs. 1 and 2 show the switchboard and connections for this type of plant, and on page 17 will be found a table, giving list prices of batteries and switchboards of various capacities.

Type A Simplified

This type of plant may, under certain conditions, be further simplified. If it is desired merely to have current available through the night, so that a lamp may be turned on for a few minutes at a time, if needed, and voltage regulation is of no importance, the counter cells may be omitted and the total number of cells reduced to 56, which will give a voltage somewhat above normal when the battery is fully charged, and too low to afford full candle power when the battery is considerably discharged. In some cases these results will be satisfactory. A battery of very small capacity, designed for such service, could be charged through lamp resistance and some of the battery switchboard instruments dispensed with.

Fig. 3 shows the connections for this simplified type, and on page 17 are given list prices of batteries of several capacities.

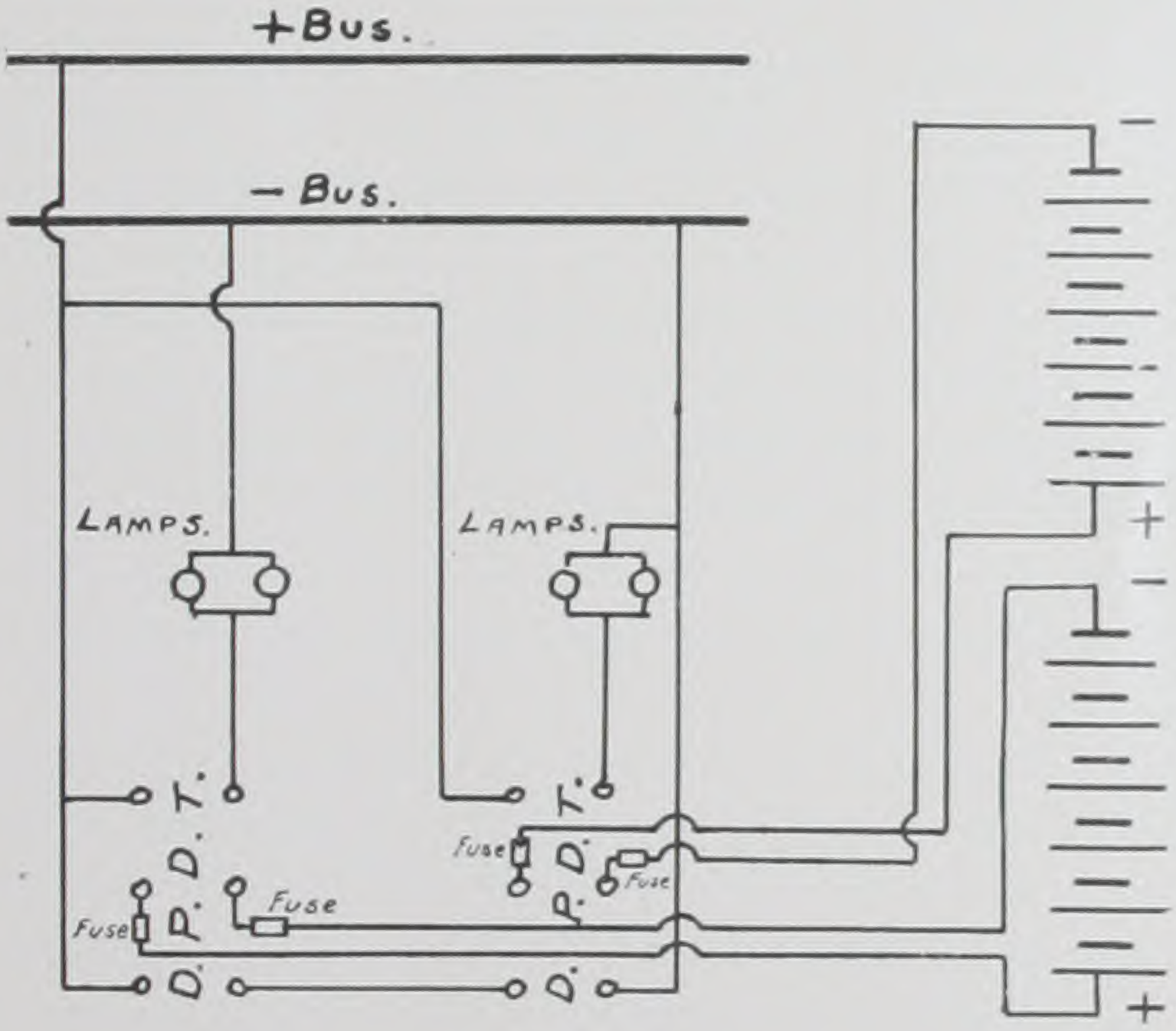

FIG. 3. DIAGRAM OF CONNECTIONS FOR TYPE A SIMPLIFIED

For Type A simplified, prices of complete switchboards have not been included, but the following list of battery instruments may be added to the generator panel:

2 D. P. D. T. knife switches, fused, for battery.
1 voltmeter switch, 4 points.
Lamps for charging (see page 17).

Type B

In this type of plant the battery is charged in one series, and the necessary voltage is obtained by raising the voltage of the generator. Counter electro-motive force cells are employed for regulating the voltage of the lamp circuit, not only while the battery is discharging, but also during charge; and as the latter voltage is the higher, a greater number of counter cells is required for this type of plant than for Type A, and these cells must be of sufficient capacity to carry current for the lights that may be in use while the battery is charging or discharging. The prices tabulated herein for plants of this type are based on the assumption that, while the battery is charging or discharging, the lighting load will not exceed the 3-hour rate of the battery, and counter cells of capacity suitable for this have been included.

For 62 cells, the generator should be capable of giving 155 volts with an output equal to the 8-hour rate of the battery plus the current for any lights that may be required while the battery is charging. A shunt-wound generator will usually be less expensive than a compound-wound machine for this type of plant, as with the former, the full field strength is available for producing maximum voltage under light load for charging.

Figs. 4 and 5 show the switchboard and connections for this type of plant, and on page 17 will be found tabulated list prices.

The counter e. m. f. cells included in Type B may be reduced from 18 to 8 if no lights are required while the battery is charging. The price of the battery will then be the same as for Type A, and the Type B switchboard price may be reduced by the amount noted in the table, due to the reduction in the number of points on the counter cell switch.

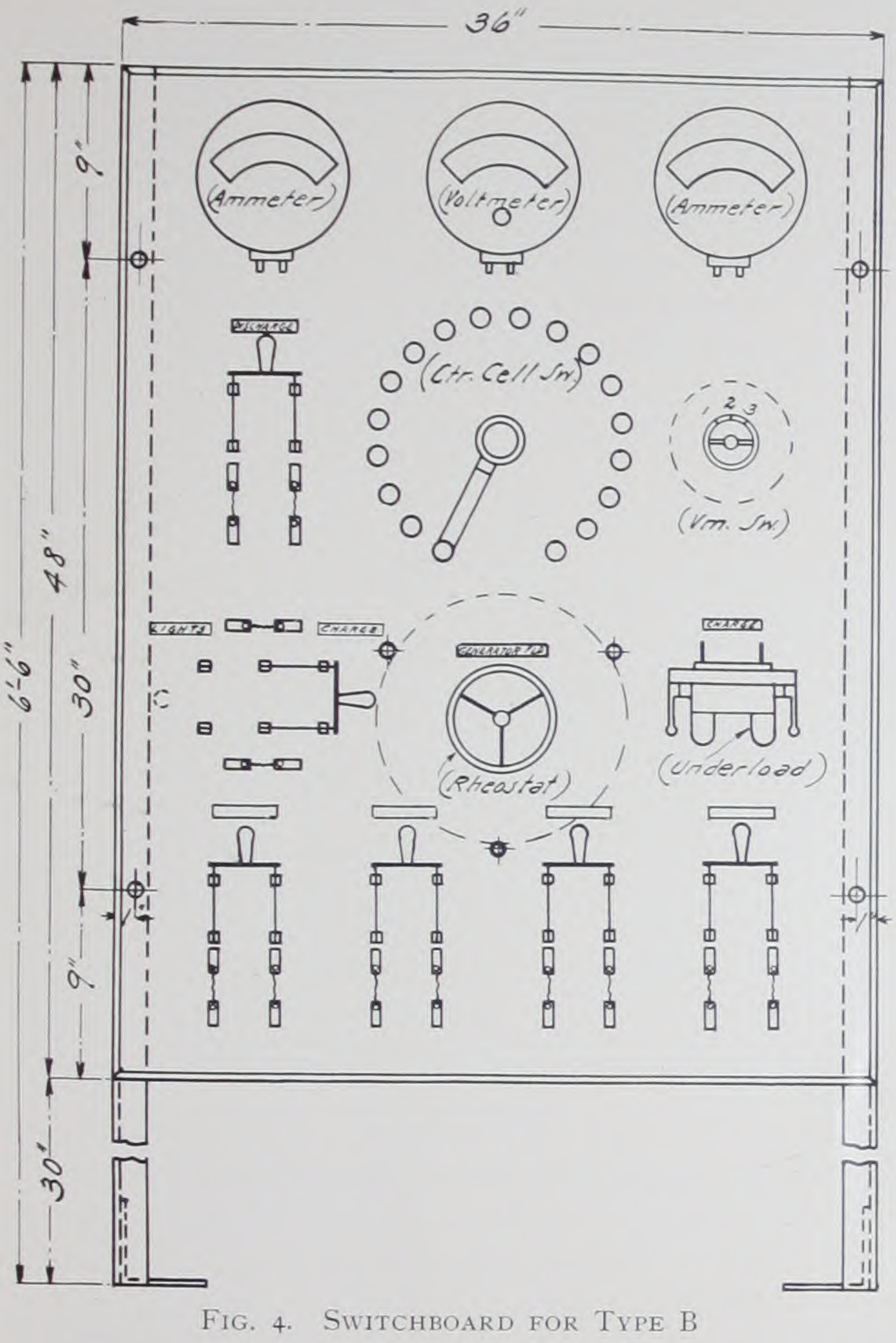

FIG. 4. SWITCHBOARD FOR TYPE B

Choice of Type

In deciding whether to install a plant of Type A or Type B, the following points should be taken into consideration :

(1) The efficiency of Type A during charge is slightly lower than that of Type B, on account of loss in charging resistances. This may be offset by the loss in counter cells in Type B if the lighting load is considerable while the battery is charging. In residential lighting plants, especially where a battery of small capacity is installed, this point is generally of minor importance.

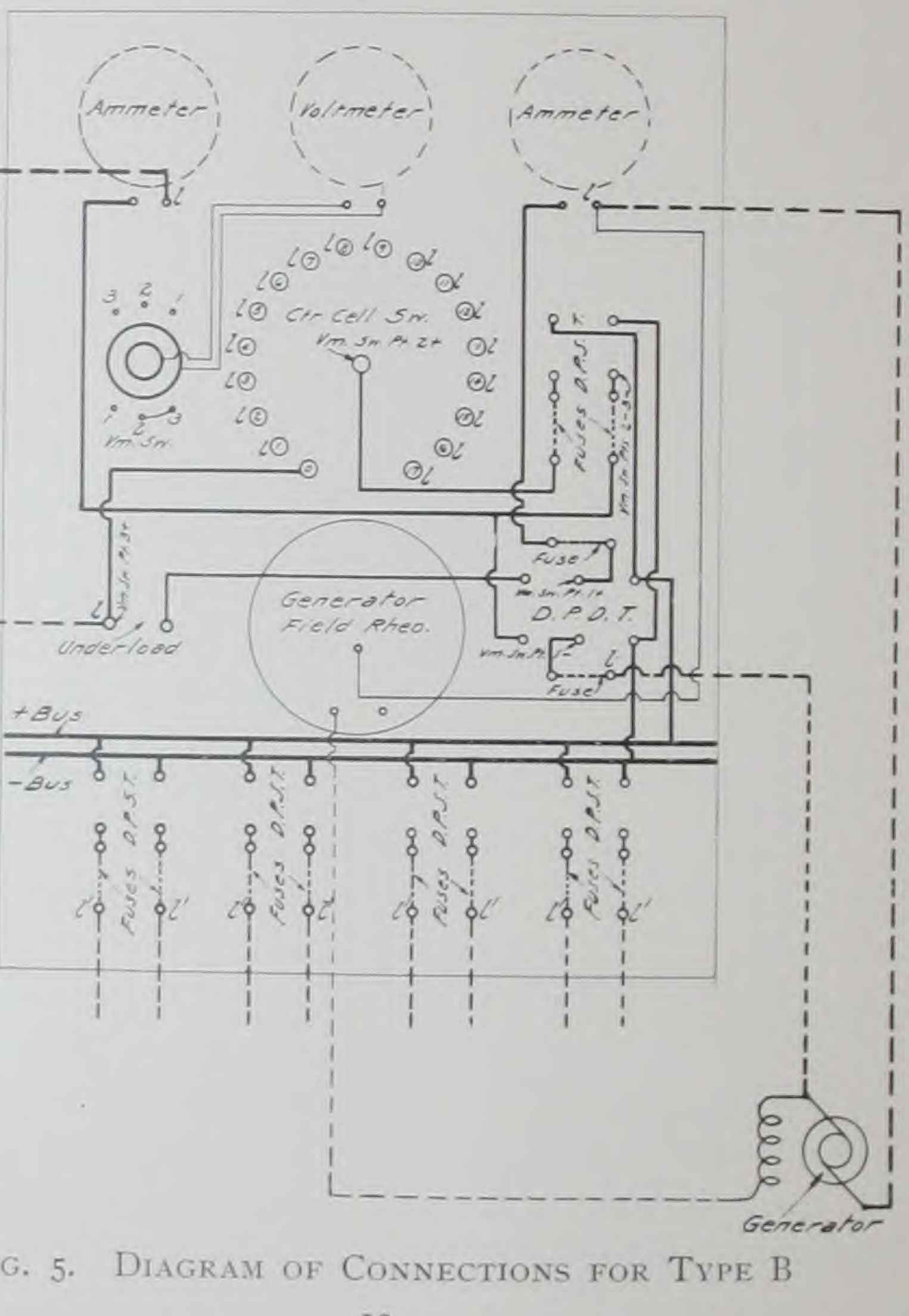

FIG. 5. DIAGRAM OF CONNECTIONS FOR TYPE B

(2) A plant of Type B requires a little more attention while the battery is charging than one of Type A, due to the necessity for increasing the generator voltage from time to time to maintain the charging rate as the battery voltage rises with charge.

(3) If the generator capacity is fixed by the requirements while the battery is charging, the generator for Type A may cost more than for Type B. This is not usually the case; while, on the other hand, the generator for Type B must necessarily be designed for a higher voltage and will therefore usually be more expensive.

(4) The cost of the battery installation for Type A is less than for Type B, as fewer counter cells are required. The same is true with regard to the switchboard and wiring.

Other Types

Other types of battery installation, principally those providing end cell control on discharge instead of counter cells, or providing a booster for charging, may be adopted for residential lighting. These types are standard for plants of larger capacity than those included herein where the requirements are more extensive and efficiency is of greater importance, and where, in many cases, an operating engineer is in charge during running hours.

Estimates, with full information covering such installation, will be promptly furnished.

Switchboards

In the tabulated estimates are included prices on switchboards. Each of these boards will consist of a black enameled slate panel measuring 3 feet wide by 4 feet high by 1½ inches thick mounted on a suitable frame, and will contain, in addition to the battery instruments, a switch and ammeter for the generator and four switches for the several lighting circuits. The complete list of instruments furnished with each of these panels is given below :

Type A

1 ammeter for generator, Weston Type K.
1 voltmeter, 150 volts, Weston Type K.
1 voltmeter switch, 4 points, round pattern.
1 ammeter for battery, Weston Type K.
1 underload circuit breaker, E. S. B. Co. Mercury Type.
1 counter cell switch, 9 points, E. S. B. Co. Type.
2 charging resistances.
1 D. P. S. T. knife switch, fused, for generator.
1 D. P. S. T. knife switch, fused, for battery.
2 D. P. D. T. knife switches for battery.
2 S. P. D. T. special knife switches for battery ammeter.
4 D. P. S. T. circuit switches, fused.

Type B

1 ammeter for generator, Weston Type K.
1 voltmeter, 200 volts, Weston Type K.
1 voltmeter switch, 3 points, round pattern.
1 ammeter for battery, Weston Type K.
1 underload circuit breaker, E. S. B. Mercury Type.
1 counter cell switch, 19 points, E. S. B. Co. Type.
1 D. P. D. T. knife switch, fused, for generator.
1 D. P. S. T. knife switch, fused, for battery.
4 D. P. S. T. circuit switches, fused.

In the tables of capacities and prices is shown the capacity of generator for which the generator instruments on each panel are designed. If a generator of larger capacity is to be installed, a corresponding increase must be made in the capacity of instruments at a small increase in price. Space is left vacant on these panels for the generator field rheostat, which is not included. The 4-lamp circuit switches are designed each for one-fourth the capacity of the generator. The number and capacity of these switches may be changed to suit special conditions, with a corresponding change in price.

In case the entire panel is not purchased from The Electric Storage Battery Company, the cell switch and underload circuit breaker will be furnished with the battery at prices shown in the tables. In such case, the cell switch will be mounted on a temporary wooden base.

Wiring

No conductors for connecting the generator or battery to the switchboard are included in the prices herein quoted. The following table of these conductors will be of service in making an estimate of their cost :

Wiring for Type A

No. of Conductors	Location	Capacity
2	Generator to Switchboard	Same as Generator Capacity
4	Battery to Switchboard	Max. Bat'y Discharge Rate
9	Counter Cells to Switchboard	Max. Bat'y Discharge Rate

Wiring for Type B

No. of Conductors	Location	Capacity
2	Generator to Switchboard	Same as Generator Capacity
1	Battery to Switchboard	Max. Bat'y Discharge Rate
1	Battery to Switchboard	Either Max. Battery Discharge Rate or Max. Charge Rate plus current required for lights while battery is charging, whichever is greater.
18	Counter Cells to Switchboard	Max. Bat'y Discharge Rate

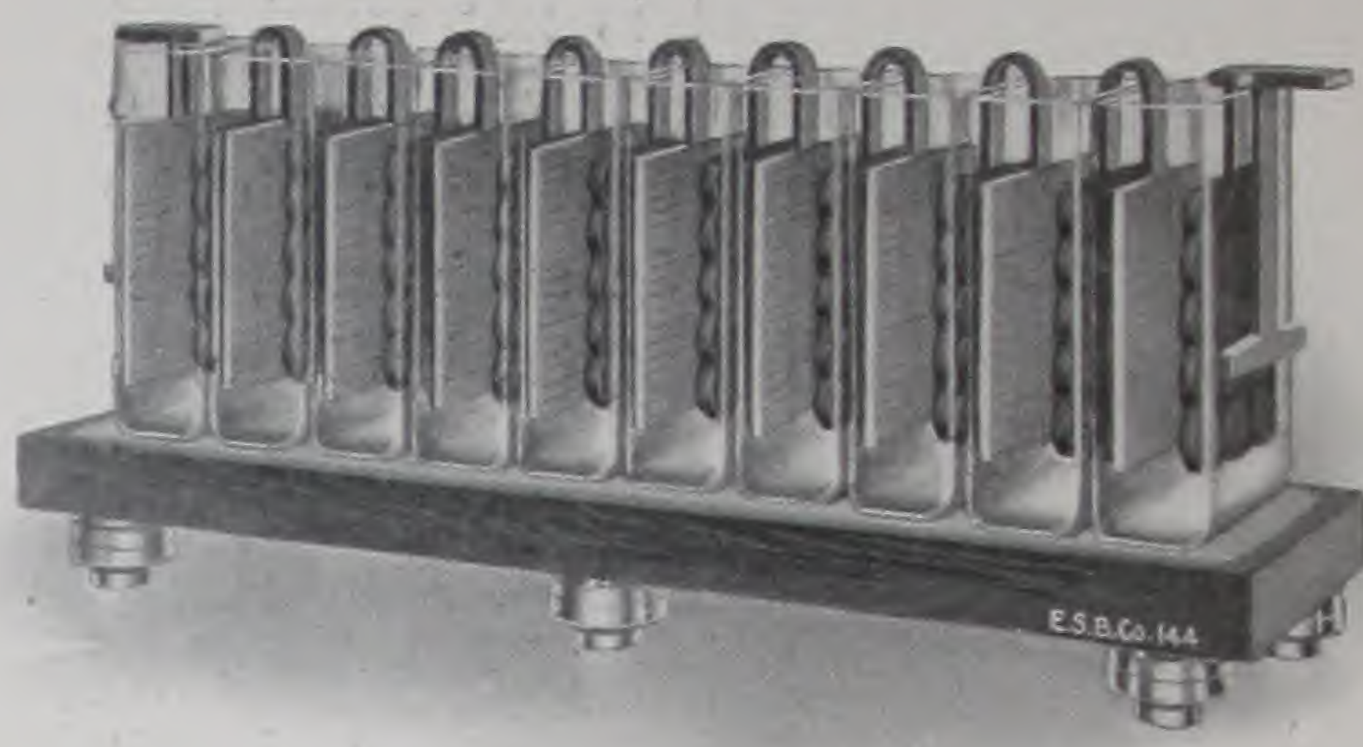

FIG. 6

Details of Installation

In figs. 6 and 7 are shown the details of two different classes of installation. Fig. 6 illustrates the method of installing 2-plate cells, the type employed for batteries of comparatively small capacity. The element consists of two plates permanently joined to a connecting strap, which, resting on the upper edges of two adjacent jars, supports the two plates, one in each cell. These cells may be assembled on shelves arranged along the wall, and to insure good insulation they should be divided into groups of eight or ten cells, each group resting on a separate sand tray supported on glass insulators. The prices quoted herein for batteries of 2-plate cells (Types BT, CT, PT and ET) include the insulators and sand trays, but no shelving.

In fig. 7 is shown the method of installing standard cells of larger capacity. Each cell rests on a wooden sand tray supported by four glass insulators, the cells being assembled in two tiers on wooden racks. These racks are of yellow pine treated with two coats of acid proof paint, and, together with the sand trays and insulators, are included in the prices quoted herein.

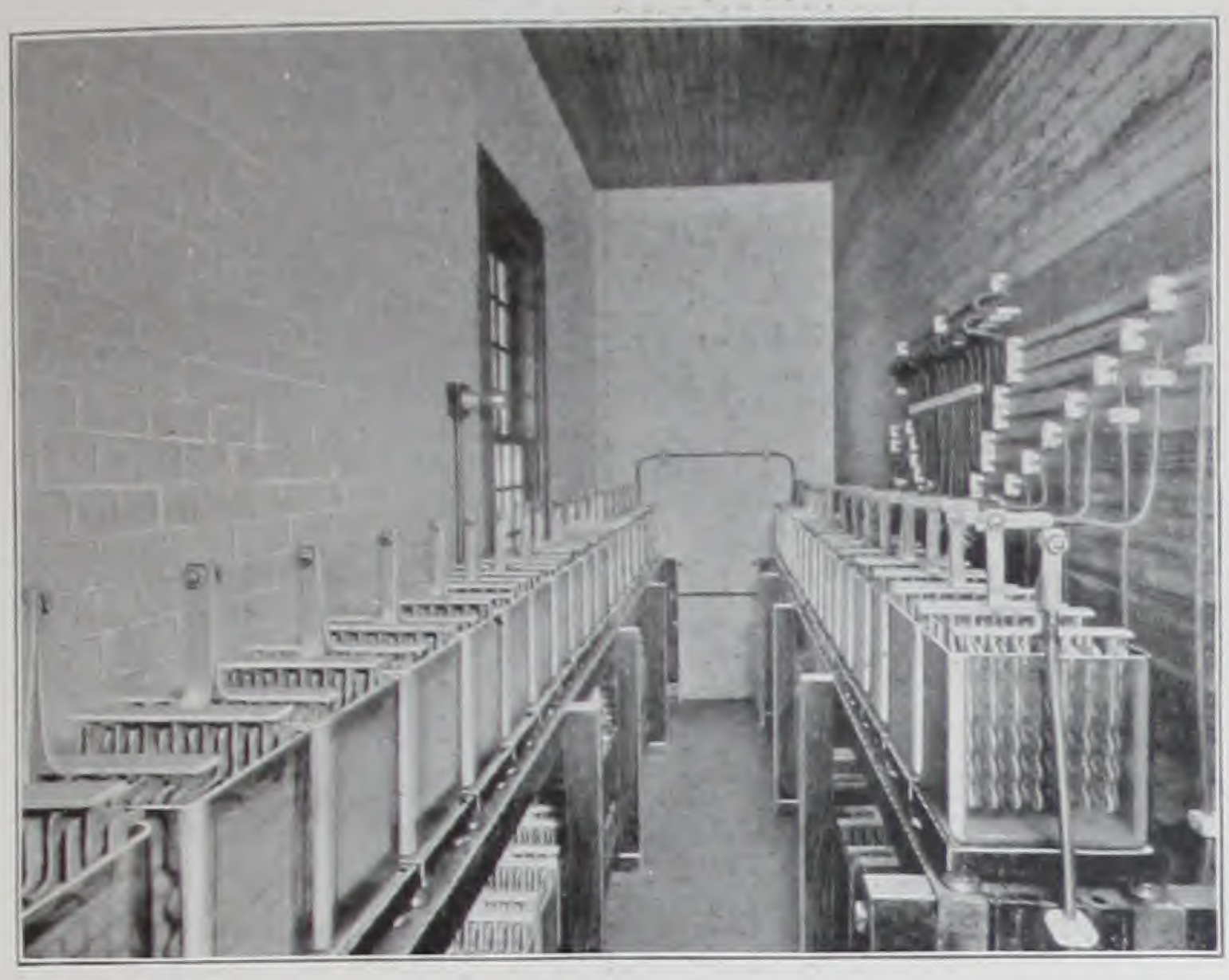

FIG. 7

Battery Material

The battery prices tabulated on page 17 include the following items f. o. b. Philadelphia :

Installations of Type A

CELLS OF TYPES PT AND ET

62 Elements
8 Counter E. M. F. Elements
72 Glass Jars
24 Bolt Connectors
45 Insulators
7 Wooden Sand Trays
1 Hydrometer
Necessary Electrolyte

CELLS OF TYPES D–7, D–9, E–7 AND E–9

62 Elements
8 Counter E. M. F. Elements
72 Glass Jars
70 Wooden Sand Trays
290 Insulators
80 Bolt Connectors
1 Hydrometer
Necessary Electrolyte
Necessary 2-tier racks

Installations of Type A Simplified

CELLS OF TYPES BT, CT, PT AND ET

56 Elements
57 Glass Jars
12 Bolt Connectors
1 Hydrometer
6 Wooden Sand Trays
38 Insulators
Necessary Electrolyte

Installations of Type B

Cells of Types PT and ET

62 Elements
18 Counter E. M. F. Elements
82 Glass Jars
36 Bolt Connectors
8 Wooden Sand Trays
50 Insulators
1 Hydrometer
Necessary Electrolyte

Cells of Types D-7, D-9, E-7 and E-9

62 Elements
18 Counter E. M. F. Elements
82 Glass Jars
80 Wooden Sand Trays
90 Bolt Connectors
330 Insulators
1 Hydrometer
Necessary Electrolyte
Necessary 2-tier racks

TYPE A.—62 CELLS. 8 COUNTER CELLS

Type of Cell	Dimensions of Cell	* Height over all	Approx. Inside Dim. of Battery Room, Cells on 2-tier racks	Battery Cap. in Amps. for 3 hrs.	for 5 hrs.	for 8 hrs.	Cap. of Gen. Instr.	List Price of Bat. exclu. of Swbd. f.o.b Phila.	List Price of Swbd. f. o. b. Phila.	List Price of Cell Sw., Rheo. and underload C. B. f. o. b. Phila.
P–T	$2\frac{9}{16}$ x 6″	$15\frac{1}{4}$″		6	4	3	100	$248.00	$356.80	$55.70
E–T	$2\frac{1}{4}$ x $8\frac{3}{4}$″	$14\frac{5}{16}$″		9	$6\frac{1}{2}$	$4\frac{1}{2}$	100	338.80	364.30	63.20
D–7	$6\frac{1}{2}$ x $7\frac{7}{8}$″	18″	11′ 3″ x 9′	15	$10\frac{1}{2}$	$7\frac{1}{2}$	150	691.50	376.50	71.60
D–9	$8\frac{3}{4}$ x 8″	18″		20	14	10	150	838.60	378.00	73.50
E–7	$6\frac{3}{4}$ x $9\frac{1}{8}$″	20″	12′ 9″ x 8′ 9″	30	21	15	150	1063.20	387.30	83.10
E–9	8 x $9\frac{1}{8}$″	20″		40	28	20	200	1314.90	390.20	84.05

TYPE A Simplified.—56 CELLS. No voltage regulation on discharge. Charge through lamps

Type of Cell	Dimensions of Cell	* Height over all	Bat. Cap. in Amperes for 3 hrs	for 5 hrs.	for 8 hrs.	List Price of Bat. exclu. of swbd. f. o. b. Phila.	50-volt Lamps for Charging
B–T	$1\frac{3}{4}$″ x $3\frac{11}{16}$″	10″	$1\frac{1}{2}$	1	$\frac{3}{4}$	$76.82	2–12 C. P.
C–T	$2\frac{5}{16}$″ x $6\frac{1}{4}$″	$11\frac{1}{4}$″	3	2	$1\frac{1}{2}$	134.50	2–20 C. P.
P–T	$2\frac{9}{16}$″ x 6″	$15\frac{1}{4}$″	6	4	3	205.32	6–16 C. P.
E–T	$2\frac{1}{4}$″ x $8\frac{3}{4}$″	$14\frac{5}{16}$″	9	$6\frac{1}{2}$	$4\frac{1}{2}$	281.57	4–32 C. P.

TYPE B.—62 CELLS. 18 COUNTER CELLS

Type of Cell	Dimensions of Cell	* Height over all	Approx. Inside Dim. of Battery Room, Cells on 2-tier racks	Bat. Cap. in Amps. for 3 hrs.	for 5 hrs.	for 8 hrs.	Cap. of Gen. Instr.	List Price of Bat. exclu. of Swbd. f. o. b. Phila.	List Price of Swbd. f. o. b. Phila.	List Price of Cell Sw. and underload Cir. Brkr.	Deduction from Price of Cell Sw. if only 8 Counter Cells are used
P–T	$2\frac{9}{16}$″ x 6″	$15\frac{1}{4}$″		6	4	3	100	$273.80	$350.00	$57.06	$13.50
E–T	$2\frac{1}{4}$″ x $8\frac{3}{4}$″	$14\frac{5}{16}$″		9	$6\frac{1}{2}$	$4\frac{1}{2}$	100	372.60	350.00	57.06	13.50
D–7	$6\frac{1}{2}$″ x $7\frac{7}{8}$″	18″	13′ 3″ x 9′	15	$10\frac{1}{2}$	$7\frac{1}{2}$	150	760.00	353.00	57.06	13.50
D–9	$8\frac{3}{4}$″ x 8″	18″		20	14	10	150	920.00	353.00	57.06	13.50
E–7	$6\frac{3}{4}$″ x $9\frac{1}{8}$″	20″	14′ 9″ x 8′ 9″	30	21	15	150	1162.00	368.80	75.13	22.00
E–9	8″ x $9\frac{1}{8}$″	20″		40	28	20	200	1435.00	372.50	75.13	22.00

* Height over all includes trays and insulators.

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